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High-Resolution Spectroscopy of Stratospheric Ethane Following the Jupiter Impact of 2009

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We report on high-resolution infrared spectroscopy of ethane (C_2H_6) performed at the latitude of an impact site on Jupiter discovered on 19 July 2009 by A. Wesley from a location in Murrumbateman, Australia. The observations used the NASA Goddard Space Flight Center's Heterodyne Instrument for Planetary Wind and Composition (HIPWAC) at the NASA Infrared Telescope Facility (IRTF) on Mauna Kea, Hawai'i. HIPWAC is a mid-infrared (9-12 μm) heterodyne spectrometer operating at the highest limit of spectral resolving power ($\lambda/\Delta\lambda$>106), providing information on atmospheric constituent abundance and temperature through fully resolved line shapes. Ethane is a stable trace product of methane photochemistry that is nearly uniformly mixed in Jupiter's stratosphere, providing an effective probe of that altitude region.

Ethane emission line profiles near 11.74 μm in the ν_9 band were measured in Jupiter's stratosphere at 25 MHz (0.00083 cm^{-1}) resolution. A sequence of spectra of ethane acquired over a range of longitude at the impact latitude (56S planetocentric) probes constituent abundance and temperature profile, both on and off the impact region. Near the site of the impact, ethane emission increased above levels measured well outside the impact region. Radiative-transfer analysis indicates increased ethane mole fraction (30% greater). Variation in the measured continuum level and line intensities within 75° of the impact longitude indicate the presence of an opacity source (haze) at altitudes near and above the tropopause and as high as the 10-mbar level near the impact site. The indication of possible haze opacity up to the 10-mbar level in the atmosphere is consistent with measurements made by HIPWAC's predecessor [1] as part of the IRTF Shoemaker Levy-9 campaign in 1994 [2].

References

[1] Kostiuk et al. 1996, Icarus 121, 431-441.

[2] Orton et al. 1995, Science 267, 1277-1288.